Announcements – Lecture V – Friday, May 23rd

1. Add/Drop: Today, Friday, May 23rd
2. No Class: Monday, May 26th , Memorial Day
3. First Lab: Tuesday, May 27th , ISB 155
4. Exam I Friday, May 30th – In Class

Quiz 3

Last Name: _____

Name:

a) Na_2S — Sodium sulfide

b) $Mg(NO_3)_2$ — Magnesium nitrate

c) $Cu_3(PO_4)_2$ — Copper(II) phosphate

d) NH_4Br — Ammonium bromide

Formula:

e) Calcium hydroxide — $Ca(OH)_3$

f) Aluminum oxide — Al_2O_3

g) Chromium(II) sulfide — CrS

h) Potassium sulfite — K_2SO_3

3.1 The Mole and Molar Mass

b) Molar Mass

$N = 6.023 \times 10^{23}\ mol^{-1}$

3.1b Molar Mass – Example_1a

a) How many **moles** of **Cs** are there in a sample that contains **6.21×10^{22} cesium** atoms**?**

b) How many **cesium atoms** are there in a sample that contains **4.33** moles of **Cs**

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a) $6.21 \times 10^{22}\ \text{atoms Cs} \left| \frac{1\ \text{mol}}{6.023 \times 10^{23}\ \text{atoms}} \right. = 0.103\ \text{mol Cs}$

b) $4.33\ \text{mol Cs} \left| \frac{6.023 \times 10^{23}\ \text{atoms}}{1\ \text{mol}} \right. = 2.61 \times 10^{24}\ \text{atoms Cs}$

3.1 The Mole and Molar Mass

b) Molar Mass

$N = 6.023 \times 10^{23}\ mol^{-1}$

3.1b Molar Mass – Example_1b

a) How many atoms of boron are present in 3.30 moles of boron trifluoride ? BF_3

b) How many moles of fluorine are present in 3.09×10^{22} molecules of boron trifluoride

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a) $3.30\ mol\ BF_3 \left| \frac{1\ B}{1\ BF_3} \right. = 3.30\ mol\ B$

$3.30\ mol\ B \left| \frac{6.023 \times 10^{23}\ atoms}{1\ mol} \right. = 1.99 \times 10^{24}\ atoms\ B$

b) $3.09 \times 10^{22}\ molecules\ BF_3 \left| \frac{1\ mol}{6.023 \times 10^{23}\ molecules} \right. = 0.0513\ mol\ BF_3$

$0.0513\ mol\ BF_3 \left| \frac{3\ F}{1\ BF_3} \right. = 0.154\ mol\ F$

3.1 The Mole and Molar Mass

b) Molar Mass

3.1b Molar Mass – Example_2

How many Grams of bromine are present in 1.02 moles of carbon tetrabromide ? CBr_4

$$\frac{1.02 \text{ mol } CBr_4}{1 \ CBr_4} \left| \frac{4 \text{ Br}}{} \right. = 4.08 \text{ mol Br}$$

$$\frac{4.08 \text{ mol Br}}{1 \text{ mol}} \left| \frac{79.90 \text{ g}}{} \right. = 326 \text{ g}$$

Where ? ... Periodic Table

3.1 The Mole and Molar Mass

b) Molar Mass

3.1b Molar Mass – Example_3

How many MOLES of water are present in 5.41 grams of this compound ?

a) 0.1 b) 0.2 c) 0.3✓ d) 0.4 e) Help

Molar Mass H_2O : 2(H) + O

$2(1.01) + 16.00 = 18.02\ g.mol^{-1}$

MOLAR MASS

$$5.41\ g\ H_2O \left| \frac{1\ mol}{18.02\ g} \right. = 3.00 \times 10^{-1}\ mol\ H_2O$$

3.2 Stoichiometry and Compound Formulas

b) Percent Composition

Express the formula C_4H_{10} (butane) in terms of % weight of each component

C_4H_{10} : $4(C) + 10(H)$

$4(12.01) + 10(1.01)$

$48.04 + 10.10 = 58.14\ g.mol^{-1}$

1 mol of C_4H_{10} weighs 58.14g of which 48.04g is C and 10.10g is H.

C: $\left(\frac{48.04g}{58.14g}\right)100 = 82.63\%$ by weight

H: $\left(\frac{10.10g}{58.14g}\right)100 = 17.37\%$ by weight

} % Composition by weight

3.2 Stoichiometry and Compound Formulas

c) Empirical Formulas from Percent Composition

Butane is 82.63% C and 17.37% H by weight. Can we determine the formula of Butane from this (can we go back!)

	C	H
a) Assume a 100g sample.	82.63g	17.37g
b) Convert grams to moles.	$\frac{82.63\,g}{12.01\,g.mol^{-1}}$	$\frac{17.37\,g}{1.01\,g.mol^{-1}}$
	6.88 mol	17.20 mol
c) Divide each by smallest mol value.	$\frac{6.88\ mol}{6.88\ mol}$	$\frac{17.20\ mol}{6.88\ mol}$
	1.00	2.50
d) Convert to whole integer	2	5

C_2H_5 ∴ What's gone wrong?

3.2 Stoichiometry and Compound Formulas

c) Empirical Formula

C_2H_5 ... C_4H_{10} ... C_6H_{15} ... C_8H_{20} ... $C_{10}H_{25}$ ..... etc

All of these are 82.63% C and 17.37% H by weight.

? What is the simplist difference between each of them

% Composition → Formula ... gives the smallest whole number ratio ... called the EMPIRICAL FORMULA

Need one more piece of information to determine the actual formula.

C: 12.01 H: 1.01
O: 16.01

3.2d Molecular_Formula – Example_1

An insect repellant, is found to be 62.58% C, 9.63% H and 27.79% O. Using Mass Spectrometry its molar mass is determined to be 230.30 $g.mol^{-1}$. What is the molecular formula of this insect repellant.

	C	H	O
a)	62.58	9.63	27.79
b)	62.58/12.01	9.63/1.01	27.79/16.00
	5.21 mol	9.53 mol	1.74 mol
c)	5.21 / 1.74	9.53 / 1.74	1.74 / 1.74
	2.99	5.48	1.00
d) x2	5.98	10.96	2.00
	6	11	2

$C_6H_{11}O_2$

$C_6H_{11}O_2$:

$6(12.01) + 11(1.01) + 2(16.00)$

$= 115.15\ g.mol^{-1}$

$\frac{230.30}{115.15} = 2$

Empirical Formula: $C_6H_{11}O_2$

Molecular Formula: $C_{12}H_{22}O_4$